**Intro ThermoChem Monday October 16th 2017**

1

Which of the equations below could be represented by the potential energy diagram?

|  |  |
| --- | --- |
| **Potential**  **Energy**  **(kJ/mol)** | **Progress of the reaction** |

1.  → 

2. → 

3.  → 

4. → 

2

Using bond energies, what is the molar heat of butane combustion?

Show all you work.

3

The temperature of water running from a tap is 10°C. 250 g of this water is poured into an aluminum saucepan which is at room temperature, 20°C. The mass of the saucepan is 520g and the specific heat of aluminum is 0.92 J/g°C.

Disregarding any heat loss to the surroundings i.e.the heat transfer is 100 % efficient, what will be the final temperature of the water and the saucepan?

|  |  |
| --- | --- |
| A) | 17°C |
| B) | 15°C |
| C) | 14°C |
| D) | 13°C |

4

A beaker contains 600 cm3 of water at 50°C. If 200 cm3 of water at 10°C is added, what will be the final temperature of the water after mixing?

|  |  |
| --- | --- |
| A) | 30°C |
| B) | 35°C |
| C) | 40°C |
| D) | 45°C |

5

|  |  |
| --- | --- |
|  | Any measure used to extinguish a fire usually tries to reduce or eliminate one or more of the three components of the fire triangle.  Two of the most common substances used to extinguish fires are water and carbon dioxide. |

A) Which component of the fire triangle does water reduce or eliminate?

B) Which component of the fire triangle does carbon dioxide reduce or eliminate?

6

Oxygen and silicon are the most abundant elements present in the Earth’s crust. However, the two elements are very rarely found in the atomic state (Si, O). Generally they tend to exist in the form of compounds, such as SiO2.

Which statement best explains the tendency of oxygen atoms and silicon atoms to combine, forming SiO2?

|  |  |
| --- | --- |
| A) | The total amount of energy contained in one atom of silicon and two atoms of oxygen is **greater** than the energy contained in one molecule of SiO2. |
| B) | The total amount of energy contained in one atom of silicon and two atoms of oxygen is **less** than the energy contained in one molecule of SiO2. |
| C) | The total amount of energy contained in one atom of silicon and two atoms of oxygen is **equal** to the energy contained in one molecule of SiO2. |
| D) | Atoms of oxygen and silicon are radioactive. |

7

The specific heat capacity of Pb(s) is 0.13 J/g°C and that of Zn(s) is 0.39 J/g°C.

Given the same mass of solid lead (Pb) and zinc (Zn), which of the following statements is true?

|  |  |
| --- | --- |
| A) | The amount of energy required to raise the temperature of Pb one degree Celsius is three times that of Zn. |
| B) | The amount of energy required to raise the temperature of Zn one degree Celsius is three times that of Pb. |
| C) | The amount of energy removed from Pb that has cooled one degree Celsius is three times that of Zn. |
| D) | The same amount of energy is required to raise the temperature of Pb and Zn one degree Celsius. |

8

Which of the following defines enthalpy?

|  |  |
| --- | --- |
| A) | The energy absorbed or released during a chemical reaction |
| B) | The change in potential energy that results from a chemical or physical change |
| C) | The energy required to start a chemical reaction |
| D) | The internal energy stored in a substance during its formation |

9

Which of the following changes are exothermic?

1. Logs burning on a camp-fire

2. The action of an ice-salt mixture used to freeze ice cream

3. Laundry that dries on a clothesline

4. A chicken roasting

5. A bolt of lightning

10

While performing an experiment, you observed that energy was released as a result of the chemical reaction between solid magnesium and hydrochloric acid. After a fixed amount of magnesium decomposed, 50 kJ of energy was released.

Which graph best represents the change in enthalpy?

Mg(s) + 2HCl(aq) → MgCl2(aq) + H2(g)



11

Identify the exothermic reactions from the following.

 → 

 → 

 → 

 → 

 → 

12

Following the evaporation of water, a student derives the following thermochemical equation.

 →  

During his research, he finds the enthalpy for the products (H2O(g)) to be 924 kJ.

Based on this information, calculate the enthalpy for the reactants (H2O(l)).

**Sketch the graph and label every part!!!!!**

13

The following statements concern the enthalpy of substances:

1. When a chemical bond forms, the enthalpy decreases.

2. When a chemical bond is broken, the enthalpy decreases.

3. When a chemical bond is broken, the enthalpy increases.

4. When a chemical bond forms, the enthalpy increases.

Which of the statements are true?

|  |  |  |  |
| --- | --- | --- | --- |
| A) | 1 and 3 | C) | 2 and 3 |
| B) | 1 and 4 | D) | 2 and 4 |

14

Classify each of the following changes as exothermic or endothermic.

1. The condensation of water on a window

2. The decomposition of water into hydrogen and oxygen

3. The digestion of food in the stomach

4. The combustion of propane in a B.B.Q.

5. The evaporation of maple-syrup sap

6. The production of aluminum by the electrolysis of bauxite

7. Peeling a potato

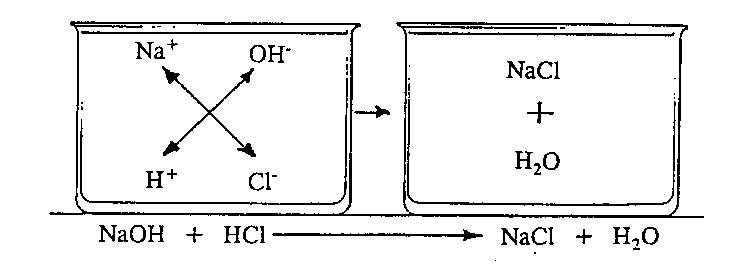
8. The sublimation of a solid air-freshener

9. The production of food by a plant through photosynthesis

10. A lit candle

15

When an acidic solution comes in contact with a basic solution, the hydrogen ions combine with the hydroxide ions, producing water. Also, the metallic ions combine with the non-metallic ions, producing a salt, as in the diagram below :



Given that the neutralizing reaction described above releases heat, which of the following statements is **correct**?

|  |  |
| --- | --- |
| A) | The enthalpy of the reactants is greater than the enthalpy of the products. |
| B) | The enthalpy of the reactants is less than the enthalpy of the products. |
| C) | The change in enthalpy (Δ*H*) is positive. |
| D) | The reaction is endothermic. |

16

The graph below illustrates a variation in enthalpy (Δ*H*) :



Which of the following equations best represents the graph?

|  |  |
| --- | --- |
| A) | NH4+(aq) + Cl**-**(aq) → NH4Cl(s) + 16.2 kJ |
| B) | NH4Cl(s) → NH4+(aq) + Cl**-**(aq) + 16.2 kJ |
| C) | NH4Cl(s) + 16.2 kJ → NH4+(aq) + Cl**-**(aq) |
| D) | NH4+(aq) + Cl**-**(aq) + 16.2 kJ → NH4Cl(s) |

17

Given the following reaction:

3 C(s) + 3 H2(g) → C3H6(g) Δ*H* = 53.3 kJ

Which of the following statements are correct?

1. The enthalpy of the reactants is greater than the enthalpy of the product.

2. This is an exothermic reaction.

3. This is an endothermic reaction.

4. The enthalpy of the reactants is less than the enthalpy of the product.

|  |  |  |  |
| --- | --- | --- | --- |
| A) | 1 and 2 | C) | 2 and 4 |
| B) | 1 and 3 | D) | 3 and 4 |

18

The following diagram shows the change in enthalpy of the substance involved in a chemical reaction.



Given this diagram, which of the following statements is TRUE?

|  |  |
| --- | --- |
| A) | This is an endothermic reaction. |
| B) | The enthalpy of the products is greater than that of the reactants. |
| C) | The Δ*H* for this reaction is negative. |
| D) | This is a spontaneous reaction. |

19

A block of ice (pure H2O) is heated from -25°C to -5°C (P = 101 kPa).

Which type of energy changes the most as you heat the block of ice? Explain.

1- Translation kinetic energy

2- Vibrational kinetic energy

3- Rotational kinetic energy

20

Using the table below, determine which graph represents the change in enthalpy for the following reaction.

CH4(g) + 2 O2(g) → CO2(g) + 2 H2O(g)

Average enthalpy associated with breaking of certain bonds in kJ/mol

|  |  |  |
| --- | --- | --- |
| H - H 435  C - H 414  C - O 351  C - C 347  O - O 138  H - O 464 | C = C 611  C = O 741  O = O 498 | C ≡ C 837  C ≡ O 1070 |

|  |  |  |  |
| --- | --- | --- | --- |
| A) |  | C) |  |
| B) |  | D) |  |

A) Write the net ionic equation for the reaction between a solution of sodium carbonate and a solution of lead (II) nitrate. Make sure your 2 compounds are properly constructed!

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B) 10.00 g of ethyl alcohol (ethanol) is warmed from 4.0 oC to 80.0 oC.

How much heat energy is involved? Sketch!!

C) Dissociate the following electrolytes:

Ca3(PO4)2­(aq) 🡪 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(NH4)2SO4(aq) 🡪 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_